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STEAM-Based Sustainable Education Training: Building Health Foundations and Fostering Generation Alpha

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Abstract
Given the urgent need to expand sustainable education, especially STEAM-based learning methods, which remain limited in Bangka Belitung Islands Province where many parents and teachers have little access or not yet familiar with such approaches, this community service program addresses the urgent need to introduce sustainable development education in early childhood by strengthening parents' roles in supporting holistic child development through health literacy and STEAM-based learning. The program aims to enhance parents' understanding and experience in integrating health principles and STEAM-based learning methods into daily family learning through a Participatory Action Research (PAR) approach. Held in Pangkalpinang City, Bangka Belitung Islands Province on August 30, 2025, the one-day workshop titled *"Sustainable Education Training Based on STEAM: Building Health Foundations and Nurturing Generation Alpha"* was attended by 30 mothers from diverse backgrounds. Sessions were facilitated by a medical doctor as well as a lecture in the Faculty of Medicine and Health Sciences of Universitas Bangka Belitung, and an early childhood educator, covering children's health topics, including nutrition, sleep, and screen time, and STEAM-based learning method. Key activities included the two workshop seasons, "*Fondasi*

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Kesehatan untuk Generasi Alfa" and "*Ibu Belajar STEAM by Wonderchild*", the practical activity "*Engineering Building Challenge"*, where participants collaboratively designed and built popsicle stick bridges, and the *STEAM Fair,* where students from the Wonderchild STEAM class performed their STEAM projects and experiments, which were presented in English. These activities result in enhancing the participant's understanding and knowledge of children's health and STEAM-based learning, as evidenced by a significant increase in the average pre-test score from 52,67 to 79,67 on questions related to early childhood health development and STEAM education.
Keywords: *STEAM education, children's health, early childhood, parental engagement, Pangkalpinang.*

Introduction

Education is crucial in building the values, knowledge, and attitudes necessary to make a sustainable future. In Indonesia, however, the integration of sustainable development education at the early childhood level remains limited, particularly in smaller cities such as Pangkalpinang, where many parents have limited understanding about health and STEAM-based learning methods. Early childhood is a critical period for forming these lifelong attitudes and habits (Sugita *et al.,* 2025) , as it is during this stage that children begin to develop foundational cognitive, emotional, and moral frameworks (Samuelsson & Park, 2017). Therefore, introducing the principles of sustainable education from an early age is essential to foster generations who are environmentally aware, socially responsible, and health-conscious. Konieczny (2023) emphasizes that teachers play a crucial role in stimulating creative and critical thinking abilities that underpin children's capacity to recognize emerging problems and seek solutions.

In Pangkalpinang City, many parents remain relatively disengaged from their children's learning processes. Parental involvement is often limited to sending their children to school and fully entrusting educational responsibilities to teachers and institutions, without active support at home. As a result, parents particularly mothers often lack up-to-date knowledge about current educational developments and approaches relevant to their children's needs. This limited engagement may place children at a disadvantage in responding to the demands of a rapidly changing world. In this context, STEAM education has emerged as an approach capable of addressing current and future educational challenges by integrating Science, Technology, Engineering, Arts, and Mathematics, while emphasizing creativity, communication, and collaboration skills essential for the 21st century (Motimona & Maryatun, 2023). However, the implementation of STEAM-based learning faces structural constraints. Teachers in Pangkalpinang face challenges due to insufficient guidance on selecting appropriate contexts for STEAM learning, as well as a lack of opportunities to participate in sharing sessions with colleagues who have already implemented STEAM in their classrooms (Nasir *et al*., 2022). Meanwhile, mothers in Pangkalpinang, most of them experience challenges in understanding how concepts of sustainability and STEAM can be translated into age-appropriate learning experiences at home. Several studies (Puspita *et al*., 2024; Weldemariam *et al*., 2017) indicate that educators and parents often lack understanding of how to translate the concept of sustainability into age-appropriate learning experiences. This condition reflects the urgency of promoting a more applied and contextually relevant sustainability education framework in areas like the Bangka Belitung Islands Province, which face challenges related to limited

resource availability and uneven access to progressive teaching practices. In this program, the targeted competencies focused on increasing parents' knowledge of STEAM education, their understanding of how STEAM-based learning can be implemented at home, and their ability to practice STEAM activities using simple and easily accessible materials. Through participatory and hands-on activities, parents were equipped with practical skills to support early childhood learning in daily family routines and to apply sustainable education principles within the home environment.

Beyond educational aspects, sustainable development in early childhood is closely linked to health-related behaviors within the family environment. Parents play a central role as children's first educators, shaping their attitudes toward learning, health, and the environment. Joseph *et al*. (2019) emphasize that active parental involvement significantly influences children's physical development and cognitive readiness to learn. They found that routines involving physical activity, balanced nutrition, and emotional support contribute to better learning outcomes and overall well-being. Their study also highlights that parents' regulation of children's screen time plays an important role in maintaining healthy behavioral patterns and preventing sedentary lifestyles from an early age. Similarly, the World Health Organization (2019) underscores that early childhood health behaviors, such as adequate sleep, restricted screen exposure, and regular physical activity will form the foundation of children's long-term well-being. The WHO guidelines call for collaboration between families and educational institutions to develop supportive environments for healthy physical and mental growth.

In the contexts of Pangkalpinang City, however, parental engagement often remains limited due to a lack of understanding about health-oriented education (Maniraj *et al*., 2023). Identify excessive screen time as a growing concern that negatively affects children's concentration, social interaction, and physical fitness. Complementing this, McCrindle and Fell (2021) describe Generation Alpha as a cohort of digital natives who are highly adaptable yet prone to technology dependency and sedentary lifestyles. Given these challenges, holding this community service program in Pangkalpinang, Bangka Belitung, is particularly important as it supports the implementation of sustainable and development education through STEAM and health-based learning especially for early childhood. Workshops on the implementation of the STEAM learning approach help teachers and mothers gain new knowledge about STEAM education and understand how project-based learning can be applied effectively in early childhood settings (Sudarti *et al*., 2025). This program provides mothers with practical exposure to interdisciplinary learning methods, strengthens collaboration between educators and families, and serves as a model for community-driven educational innovation in regions with limited access to such programs.

Method

This project employed a Participatory Action Research (PAR) approach, inspired by the model proposed by Kemmis and McTaggart (2005). While not adopting the full PAR framework, this community service activity incorporated its participatory elements through three key phases, namely planning, acting, and observing, to facilitate collaborative and cyclical engagement among stakeholders in generating contextual and practical solutions, while the reflecting and re-planning cycles were not formally conducted due to time constraints and the one-day workshop design. Therefore, the PAR process was limited to a single cycle. The participatory design allowed parents to act as co-learners, actively contributing to problem identification,

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solution implementation, and assessment, rather than serving as passive recipients of information. The training was conducted on August 30, 2025 at Orbit Resto & Café, Pangkalpinang, Bangka Belitung Islands Province. A total of 30 mothers were selected through open registration and short reflective essays describing their motivations to join the program. The participants represented diverse professional and educational backgrounds, reflecting a cross-section of urban families in Pangkalpinang.

The sessions were facilitated by two key experts who brought complementary professional backgrounds to the program. Dr. Rosalin Yuniarti Ma'ruf, Sp. PD, a physician and lecturer at the Universitas Bangka Belitung, contributed her expertise in health literacy, focusing on children's physical and mental well-being. Her sessions emphasized the importance of balanced nutrition, adequate rest, and parental awareness in supporting early childhood health. Meanwhile, Ghaida Roshuna, S. Psi., CDA, the founder of Wonderchild Pangkalpinang, served as the educational facilitator. With her background in psychology and early childhood education, she designed and delivered STEAM-based learning presentations and discussion as well guided participants through hands-on practical activities.

Figure 1. Participatory phases based on the PAR model

The program was implemented through three main phases: planning, action, and observation. In the planning phase, the training topics were designed based on the speakers' teaching experiences at Wonderchild, supported by insights from relevant papers, journals, and current issues related to children's health. This approach aligns with Andika *et al*. (2024), who conducted a community service project on STEAM-based teaching module training for kindergarten teachers in Lahat Regency, South Sumatra. In their preparation phase, they focused on developing training materials, organizing the tools and equipment needed, and arranging the implementation schedule. Similarly, in this program, the presentations emphasized health literacy, sustainable parenting practices, and STEAM-based activities that utilized simple and easily accessible materials. In the action phase, a one-day workshop was conducted through presentations, theoretical discussions, demonstrations, and hands-on activities integrating the themes of health, sustainability, and STEAM education. The training was delivered using Indonesian languages. Participants collaboratively engaged in the "Engineering Building" project, constructing miniature bridges from popsicle sticks to experience the application of STEAM principles through creative and practical learning experiences. During the observation phase, participant engagement was observed and documented through field notes and photographs, highlighting their participation, collaboration, and creativity throughout the activities. In addition, pre-test and post-test instruments were administered to participants to assess the extent to which this community engagement program can help build their understanding and knowledge.

Results and Discussion

The one-day community training program successfully combined two complementary strands of learning, child health literacy and STEAM-based sustainable education to strengthen

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parents' understanding and practical competence in nurturing early childhood development. The workshop involved interactive lectures, hands-on collaborative projects, demonstrations, pre-test and post-test, reflecting a holistic vision of sustainable education through health and creativity. At the beginning, participants were asked to complete a pre-test to assess their understanding of health principles and STEAM-based learning methods for children before receiving the learning materials from the speakers. The pre-test form consisted of 10 multiple-choice questions related to children's health development and STEAM education. The result showed that participants' scores ranged from 40 as the lowest score to 70 as the highest score. Detailed results are presented in Table 1.

The first session, delivered by Dr. Rosalin Yuniarti Ma'ruf, Sp.PD, emphasized the essential health pillars for early childhood development, they are balanced nutrition, regular physical activity, sufficient sleep, and mental-social well-being. Despite this focus, Jumarniati & Fitriani (2023) note that parents' attitudes toward their children's health remain relatively low, underscoring the importance of actively engaging them in health education. As illustrated in her presentation *"Fondasi Kesehatan untuk Generasi Alfa"*, children born between 2010–2025 face increasing health challenges due to sedentary lifestyles and excessive screen time. Parents were encouraged to act as role models, establishing healthy routines and managing digital exposure through consistent, collaborative, and compassionate (3K) parenting. The discussion highlighted that health is not a separate domain from learning but a prerequisite for optimal cognitive and emotional growth (Joseph *et al*., 2019). Observations during the session revealed that parents showed strong curiosity in learning the materials, as reflected in active qna sessions where participants engaged in discussions both with the speaker and with one another. A total of seven questions were directly addressed to the speaker, and participants also had opportunities to share their experiences and understanding through peer discussions.

Figure 2. Presentation and Discussion of Children's Health Topic

The second session, "Ibu Belajar STEAM by Wonderchild," facilitated by Ghaida Roshuna, S.Psi., CDA, introduced participants to the integrated dimensions of Science, Technology, Engineering, Arts, and Mathematics (STEAM). The facilitator emphasized that STEAM is not merely about mastering technical skills such as coding or robotics, but about connecting everyday experiences with inquiry-based, creative, and solution-oriented learning (Nuria, 2024) . Participants explored how science and technology emerge from daily phenomena, such

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as understanding why butter softens at room temperature or how heat energy in an oven transforms cake batter into a solid form. The "Making Cake the STEAM Way" exercise demonstrated how simple domestic routines can become learning laboratories that foster scientific reasoning, mathematical thinking, and artistic creativity simultaneously. Throughout the session, parents actively engaged with the facilitator by asking questions, five questions were directly addressed to the speaker, sharing their experiences, and discussing how similar STEAM-based explorations could be applied at home. Their curiosity and enthusiasm reflected a growing interest in applying everyday household activities with meaningful educational value.

Figure 3. Presentation on the STEAM Learning Topic

During the Engineering Building Challenge, participants were divided into small groups and tasked with constructing bridges using popsicle sticks and glue, guided by basic engineering principles. The activity fostered teamwork, problem-solving, and mathematical reasoning as mothers calculated symmetry, balance, and load distribution while experimenting with different bridge designs. Observation notes showed that participants engaged actively in brainstorming and testing ideas, expressing excitement and pride during the STEAM Fair exhibition. This exercise demonstrated that experiential learning can transform passive understanding into active skill development, aligning with Yakman & Lee (2012) principle of transdisciplinary STEAM education. This activity aligns with the idea of Huda *et al*. (2024), where children can build structures and express their creativity and imagination using building blocks. Parents acknowledged that similar projects could easily be replicated at home using recycled materials, making sustainable education practical and enjoyable for families. This activity therefore fulfilled one of the community service program objectives, namely enhancing parents' practical skills in applying STEAM-based learning at home.

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Figure 4. Engineering Building Creation by Participants

Each team conducted a trial and presentation of their Engineering Building projects during the STEAM Fair, where participants showcased the miniature bridges they constructed from popsicle sticks. This stage allowed parents to test the strength and stability of their designs while explaining the concepts of balance, structure, and material use they had applied.

Figure 5. Trial and Presentation of Engineering Building Projects

After the workshop, participants were asked to fill the post-test to assess improvements in their understanding following the learning sessions. Details of the pre-test and post-test score are presented in Table 1. below:

Table 1. Pre-test and Post-test Results

No.	Score	Pre-test	Post-test
		Persons	Persons
1.	10	0	0

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2.	20	0	0
3.	30	3	0
4.	40	6	0
5.	50	7	0
6.	60	8	2
7.	70	6	8
8.	80	0	11
9.	90	0	7
10.	100	0	2
Average Score		52,67	79,67

Based on the pre-test and post-test results above, it can be observed that there is a significant improvement of the understanding from the audience after their involved in this workshop activity. This prove that this community service program was successfully rise the understanding of 30 mothers in Pangkalpinang City, Bangka Belitung Province about health development and STEAM learning method that can be applied to support children's learning at home. The program concluded with the STEAM Fair, an event where students from Wonderchild Pangkalpinang STEAM class performed on stage to present and showcase the projects they had developed during their lessons. In this open public event, children confidently presented their works, ranging from simple machines and art-integrated science models to creative engineering prototypes and basic chemical lab experiments entirely in English. Through this performance, they shared their ideas, explained their learning processes, and reflected on their problem-solving experiences, thereby strengthening both communication skills and self-expression. Communicating is one of the aspects of STEAM learning that develops children's language and communication skills with others; it involves working individually or in groups, as well as sharing and discussing ideas through activities such as conversation, listening, writing, and presenting (Novitasari, 2022).

Figure 6. STEAM Fair

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Conclusion and Recommendations

The community service program "Sustainable Education Training Based on STEAM: Building Health Foundations and Nurturing Generation Alpha" was successfully held on August 30, 2025, at Pangkalpinang City, Bangka Belitung Islands Province. The activity combined family health literacy and STEAM-based sustainable education to strengthen parents' ability to support early childhood development through practical and creative learning experiences at home (Imamah & Muqowim, 2020). Thirty mothers participated. The sessions were facilitated by Dr. Rosalin Yuniarti Ma'ruf, Sp.PD, who discussed children's health topics including nutrition, sleep, and digital habits, and Ghaida Roshuna, S.Psi., CDA, who led interactive STEAM workshops on inquiry, creativity, and sustainability. Activities included the Engineering Building Challenge where participants built miniature bridges and the STEAM Fair, where children showcased their projects and experiments in English. The program proceeded smoothly, fostering active participation, curiosity, and collaboration among parents. Discussions and activities demonstrated growing awareness of how STEAM and health principles can be integrated into daily family routines to promote holistic child development.

Future community service initiatives related to STEAM education and early childhood health are recommended to focus on the following:

1. Expand future programs to include early childhood and kindergarten teachers to strengthen classroom-based implementation of sustainable and STEAM education.
2. Encourage continued collaboration between educators, health professionals, and parents for mentoring and community-based learning.
3. Develop simple, home-based STEAM modules using local materials to guide parents in applying sustainability learning at home.

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